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GENERALIZED LANGUAGE LEARNING BY CHILDREN WITH SEVERE MENTAL RETARDATION: EFFECTS OF PEERS' EXPRESSIVE MODELING

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In this study, we investigated the conditions that contribute to observational learning of generalized language in children with severe mental retardation. Matrix-training strategies were used to teach 6 children with mental retardation to combine known words into two- or three-word utterances consistent with syntactic rules. Subsequently, the children learned two or more unknown words concurrently, inducing word–referent relations consistent with these word order rules. Generalized learning of responses not taught directly was shown to be under experimental control using a multiple baseline design across submatrices. Expressive modeling of only four or five responses was sufficient to promote recombinative generalization in the expressive and receptive modalities. Thus, 95% to 98% of subjects' learning was attributed to generalization processes. This study demonstrates how the efficiency of language training with children with mental retardation might be enhanced by coupling observational learning and matrix-training strategies.

DESCRIPTORS: generalized language learning, mental retardation, observational learning, verbal behavior

Observational learning influences much of children's socialization, including their language development (Bandura, 1977; Bijou, 1976; Flavell, 1977; Piaget, 1952; Whitehurst, 1978; Yando, Seitz, & Zigler, 1978). Interventions based on modeling have been used extensively to teach receptive and expressive language repertoires to preschool children (Brown, 1976; Cocking, 1977; Goldstein, 1984; Morgulas & Zimmerman, 1979; Whitehurst, 1977; Whitehurst, Ironsmith, & Goldfein, 1974) and to language-delayed children (Courtright & Courtright, 1976, 1979; Goldstein & Brown, 1989; Prelock & Panagos, 1980). Although modeling has been widely recognized as a powerful process for facilitating children's language learning, a number of investigators have pointed out that modeling procedures have not been used to their fullest extent (Baer, Peterson, & Sherman, 1967; Browder, Schoen, & Lentz, 1986–1987; Cullinan, Kauffman, & LaFleur, 1975; Glidden & Warner, 1982). This seems surprising given the prevalent use of imitation as a component of teaching. For example, if a child does not respond expressively, a teacher might request the child to imitate a modeled response. This type of modeling has been used frequently in language intervention studies (e.g., Garcia, 1974; Garcia, Guess, & Byrnes, 1973; Guess, Sailor, Rutherford, & Baer, 1968; Lovaas, 1977; Lutzker & Sherman, 1974; Smeets & Striefel, 1976). However, a fuller use of modeling occurs when the desired response occurs not only upon the occasion of the model itself but in the context of other stimuli that are discriminative for that response. That is, language production should occur not just as an immediate response to a model but in response to discriminative stimuli that differ topographically from the response. Moreover, novel combinations of responses to such stimuli are also desirable.

Whitehurst and Vasta (1975) have referred to observational learning that results in generalized language learning as *selective imitation*. Whitehurst and his colleagues have taught rather complex syntactic forms to normal preschoolers using modeling procedures. These children used the modeled syntactic form to describe novel pictures, thus producing sentences they had not heard modeled. Wetherby (1978) and Goldstein (1984) provided an explanation of how such novel syntactic re-

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sponding can be established through matrix-training procedures or *recombinative generalization.* For example, the production of object-preposition-location utterances may require a child to discriminate relations between three environmental referents and their associated words, with a syntactic rule dictating the ordering of those words. Recombinative generalization describes the process of producing or responding to novel utterances; when familiar stimuli are recombined in novel ways, stimulus elements continue to exert precise and appropriate control over corresponding portions of the novel responses. This type of discriminative responding might explain instruction-following responses or verbal responses involving known words from a verb and noun class used in a novel combination (e.g., "paint the car" based on previously taught responses, "push the car" and "paint the picture"). More importantly, the application of word order rules permits the learning of word–referent associations involving new words or referents (e.g., "dangle the line"). This process of discriminative responding can help explain how children learn to respond appropriately to or with untrained combinations of words from two or more word classes. Whitehurst and Vasta's concept of selective imitation seems to combine observational learning and recombinative generalization.

Preliminary investigations with individuals with developmental disabilities (Goldstein & Brown, 1989; McCuller, 1980) have integrated the potential of observational learning and recombinative generalization. These studies are highlighted because the investigators were not only interested in whether individuals with developmental disabilities demonstrated observational learning; they also investigated how observational learning, if initially absent, could be facilitated. McCuller (1980) taught 3 severely mentally retarded adults to extend their receptive action-object instruction-following repertoires when peers modeled responses to unfamiliar action-object instructions. Goldstein and Brown (1989) investigated the effects of receptive and expressive modeling on the learning of object-preposition-location utterances with language-delayed preschoolers. Modeling usually resulted in extensive observational learning. Also, preliminary results in these two studies supported the use of an adjacent-trial observation training procedure to promote learning of responses that were not learned when modeled in nonadjacent trials.

The present study sought to extend these findings by investigating the effects of expressive modeling experiences on the observational learning of generative language by children with severe handicaps. Teaching dyads were created in a school for children with developmental disabilities. Children with mental retardation modeled expressive responses for other more severely mentally retarded schoolmates. The following questions were addressed: (a) Are new object-location and object-preposition-location language responses modeled by peers in nonadjacent trials learned observationally? (b) When responses modeled in nonadjacent trials are not learned, does adjacent-trial observation training promote the acquisition of those responses, and are new responses modeled subsequently in nonadjacent trials learned observationally? (c) Do modeling procedures coupled with the application of matrix-training principles result in recombinative generalization of object-location and object-preposition-location responses? (d) To what extent does observational learning affect responding in the expressive and receptive language modalities? (e) To what extent do newly acquired responses transfer to other school environments?

METHOD

Subjects

Six individuals with severe mental retardation, aged 6 years, 9 months to 9 years, 3 months, enrolled in a public school for mentally retarded students participated. All subjects were enrolled in the school's speech/language therapy program prior to and during their participation in the study. The subjects demonstrated restricted use of two-word (Subjects 1, 2, and 3) or three-word (Subjects 4, 5, and 6) combinations as reflected during samples of their spontaneous language during structured play periods with the experimenter. Subjects 1, 2, and 3 did not produce any object-location utterances (e.g., "hat chair") during language sampling at the outset of the study. Subjects 4, 5, and 6

Table 1
Characteristics of the Target Subjects

	Subject					
	1	2	3	4	5	6
Age	8 years, 4 months	7 years, 5 months	6 years, 9 months	8 years, 5 months	8 years, 3 months	9 years, 3 months
IQ	38b	41s	35b	46b	43s	42b
MLR						
Pre	2.51	1.34	1.55	4.43	3.09	1.78
Post	2.75	1.57	1.73	3.94	2.78	2.24
SICD—Receptive age (months)						
Pre	28	12	24	36	40	48
Post	28	32	32	44	40	48
SICD—Expressive age (months)						
Pre	28	20	24	36	36	32
Post	28	20	28	44	36	36
Imitation testing						
Nonverbal	76%	56%	84%	96%	96%	88%
Verbal	30%	20%	10%	70%	20%	70%

Note. For IQ, s refers to Slosson and b refers to Stanford-Binet Form L-M. MLR, mean words per utterance. SICD, Sequenced Inventory of Communication Development.

occasionally uttered prepositional phrases (e.g., "sit on the floor"), but did not produce object-preposition-location utterances (e.g., "juice in cup"). Subjects were involved in the study for 4 to 5 months.

Each subject was assessed using the *Sequenced Inventory of Communication Development* (SICD) (Hedrick, Prather, & Tobin, 1975). As shown in Table 1, Subjects 1, 2, and 3 demonstrated receptive age equivalence scores between 12 and 24 months and expressive age equivalence scores between 20 and 28 months. Subjects 4, 5, and 6 demonstrated receptive scores between 36 and 48 months and expressive scores between 32 and 36 months.

A 25-item nonverbal imitation test was conducted to ensure that requests to imitate were viable for teaching receptive language. The accuracy of nonverbal imitation ranged from 56% to 96% (see Table 1). A verbal imitation assessment included 10 items from the SICD requiring imitation of digits, words, and sentences and all the words in each subject's language matrix. This assessment was conducted to ensure that subjects attempted to imitate verbally and to determine whether lack of intelligibility might compromise any subject's potential for spontaneous production of two- or three-word utterances. All subjects attempted to imitate on each test trial (see Table 1). A good deal of variability was evidenced in intelligibility, but all subjects were able to produce discriminable approximations to the words in their matrices.

Thirteen children served as models during the study. The models, although moderately or severely mentally retarded, represented a large range in age (7 years to 15 years, 2 months) and sophistication (IQ range, 31 to 54). They were selected on the basis of (a) availability, (b) high levels of mastery of training words, and (c) general compliance and cooperativeness. Two models were assigned to each target subject, but substitutions were made as needed to fill in for absentees and to compensate for scheduling difficulties.

Setting and Stimuli

Experimental sessions were conducted in a quiet room in the school. Each target subject was scheduled to participate in a peer modeling session 5 days each week. The length of each session was approximately 20 min.

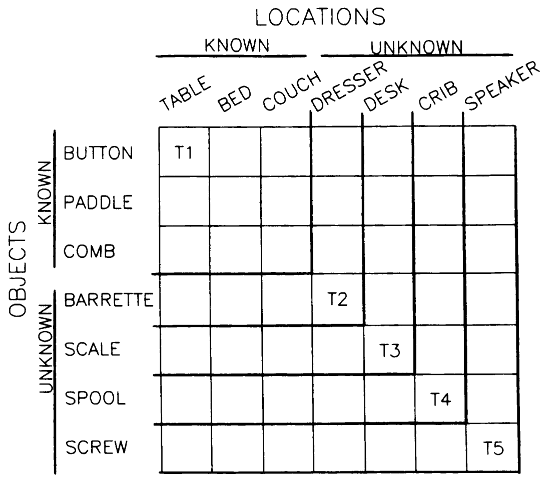

Figure 1. An example of a 7 × 7 object-location language matrix including a 3 × 3 submatrix of known words (Submatrix 1). Training items are designated with T1–T5, and their associated submatrices are surrounded with bold lines.

The model and target subject sat beside the experimenter at a table facing a doll house containing miniature plastic furniture. Furniture locations were rotated daily to prevent inappropriate responses based on position. Seven objects were placed in front of the dollhouse for the object-location subjects, and three objects were placed in front of the dollhouse for the object-preposition-location subjects. An assortment of 12 pieces of miniature furniture were placed throughout the five rooms in the house. The actual objects and locations varied among subjects.

Matrix Organization

Preassessment. Preassessments were conducted with each subject to identify object, location, and preposition words that were then used to construct individual matrices for each subject. Assessments included both receptive and expressive identification of words. Testing began with initial pools of 15 objects, 18 locations, and 13 prepositions.

During receptive trials, a group of five to 15 objects or five to nine locations were presented, and the subject was asked to identify an object on request by pointing. Expressive identification of object and location words was accomplished by requiring subjects to label each item presented by the experimenter. To assess prepositions, the experimenter placed a miniature table in front of the subject and instructed him or her to manipulate a small known object following a command containing a preposition (e.g., "put it *on* the table."). Subjects expressively identified the location (preposition) of the object when placed by the experimenter in response to "where is the *block*?"

The criteria for selection of known words were five correct of five receptive trials and three correct of three expressive trials. The criteria for selection of unknown words were zero correct of five receptive trials and zero correct of three expressive trials. Occasionally, one additional receptive trial was included when one correct response appeared to be due to chance or when one incorrect response was due to a lapse of attention. Subjects had to respond accurately to at least two prepositions to be taught a three-word (object-preposition-location) matrix.

Language matrices. Based on preassessments, language matrices were developed with either two or three dimensions. Individual 7 × 7 object-location matrices were developed for Subjects 1, 2, and 3. As shown in Figure 1, object words were placed along the vertical axis and location words bordered the horizontal axis to constitute a two-dimensional matrix. Three of the object words and three of the location words constituted a known word submatrix.

Individual 3 × 5 × 6 object-preposition-location matrices were developed for Subjects 4, 5, and 6 (see Figure 2). The three-dimensional matrices included three known object words, two known and three unknown prepositions, and three known and three unknown locations. Thus, a 3 × 2 × 3 object-preposition-location submatrix was comprised of known words.

The common feature of the two-dimensional and the three-dimensional matrices was the inclusion of an entire submatrix of only known words and several submatrices that included unknown words. A response from this known submatrix was modeled at the outset of intervention to promote recombinative generalization as efficiently as possible (see Goldstein, Angelo, & Mousetis, 1987). Subse-

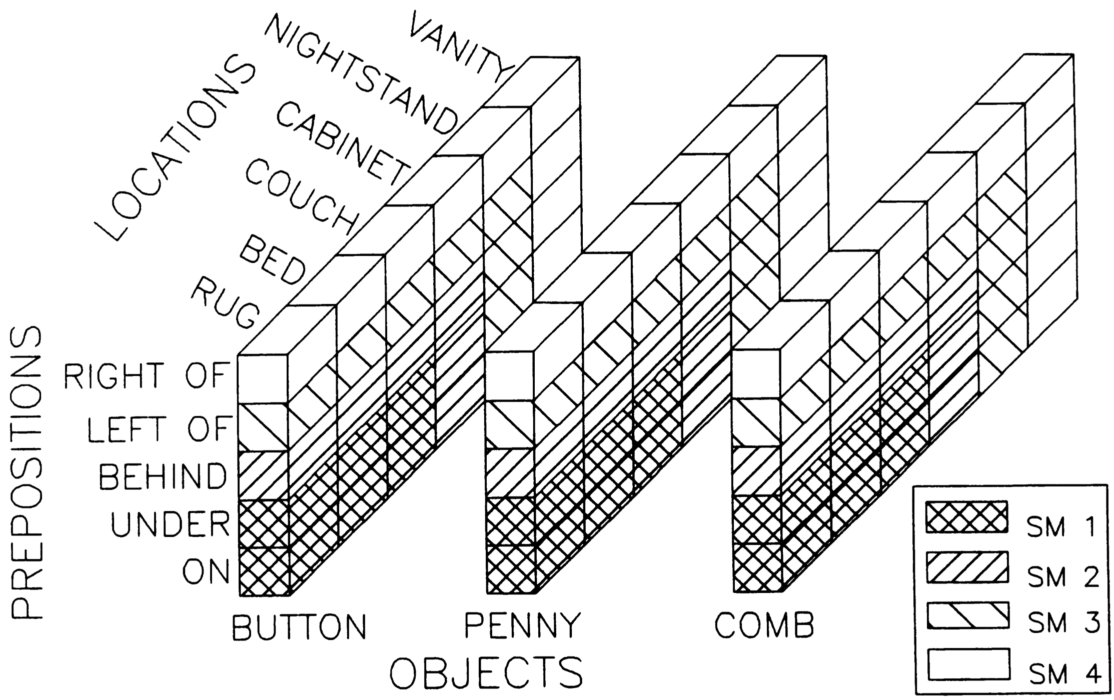

Figure 2. An example of a 3 × 5 × 6 object-preposition-location language matrix including a 3 × 2 × 3 submatrix comprised of known words (Submatrix 1) and three additional submatrices comprised of unknown words.

quently, each submatrix reflected the possible generalization predicted experimentally given the introduction of a specific training item comprised of unknown words. For example, in Figure 1 the introduction of Training Item 2 (T2) includes a new object word *barrette* and a new location *dresser*. Generalization under experimental control was predicted for novel combinations of *barrette* with previously known locations (table, bed, and couch) and *dresser* with previously known objects (button, paddle, and comb). Similarly, the introduction of Training Item 3 (T3) expanded the possible generalization to combinations of known words with the new object, *scale,* and the new location, *desk.*

Experimental Procedures

Two types of instructions were presented. For expressive instructions presented to the (peer) model or the target subject, the experimenter placed one object with respect to a location and asked, "What did I do?" The children were required to describe the event with a complete and correct two-term or three-term utterance (e.g., "shoe [on] speaker" or "button under cabinet"). The experimenter presented receptive instructions such as "put the bean on the couch" only to the target subject. The subject responded by placing an object with respect to a specific location.

Modeling trials (for the model subject) and probe trials (for the target subject) were randomly ordered on computer-generated data sheets. The number of trials per data sheet ranged from 40 to 50. Each modeling session included 12 modeling trials by a peer and 28 to 38 trials for the target subject comprised of (a) four observational acquisition probes, never immediately preceding or following a modeling trial, to probe for observational learning, (b) one opposite modality probe to assess transfer from the expressive modality to the receptive modality for the modeled response, (c) three to eight expressive recombinative generalization probes (and never less than 25% of the untrained responses from the subject's current submatrix) to detect novel utterance productions combining words to which the target child was exposed only through peer modeling, (d) three to eight receptive recombinative generalization probes from the current submatrix to detect crossmodal transfer to novel utterances combining words to which the target child had been exposed, and (e) seven to 14 receptive and seven to 14 expressive baseline and maintenance probes to evaluate the maintenance of experimental control. Baseline probes sampled one quarter of the unknown submatrix object-location responses initially and one eighth of the unknown object-preposition-location responses initially in each modality. When intervention had progressed to the third submatrix, only responses that included two unknown words were included as baseline measures. This was done to reduce the likelihood of subjects learning unknown object or location words through random responding or a process of elimination. As intervention progressed and there were more learned responses, 100% sampling of the maintenance responses was eventually reduced to 25% sampling from the two-dimensional matrices and to 12.5% sampling from the three-dimensional matrices in each modality.

Experimental conditions. Probes administered to the target subject contributed data to baseline, modeling, and maintenance conditions within the same sessions. The distinction between these conditions had to do with whether peer models (a) had not yet responded to stimuli from a particular submatrix (baseline condition), (b) were currently responding to stimuli from a particular submatrix (modeling condition), or (c) had previously responded to stimuli from a submatrix (maintenance condition). The concentration of probe trials contributing data for each of these conditions varied as outlined above, but the procedures for administering probes remained constant.

If subjects failed to acquire responses modeled on nonadjacent trials, they participated in adjacent-trial observation training. On adjacent-trial observation trials, the experimenter instructed the model to demonstrate a response and then presented the same instruction to the target subject. If the target subject did not imitate the response accurately, he or she was told to watch the model and the trial was repeated. Both the model and the subject were reinforced for correct responses. Twelve adjacent-trial observation trials replaced the 12 modeling trials conducted per session. This intervention was discontinued when the subject performed four correct of four nonadjacent observational acquisition probes.

After completing the intervention, a review of all the responses in each subject's matrix was conducted. This review was comprised of a random ordering of each receptive and expressive response in the entire matrix.

Transfer tests. At the completion of the study, two transfer tests were used to assess generalization across people and settings. The first transfer test was a classroom probe, with 50 selected matrix items administered by each subject's teacher in the classroom. The teachers were given practice administering and scoring receptive and expressive responses with the experimenter acting as the child. The experimenter generated the data sheets and provided the necessary stimuli, data sheets, and written instructions. The dollhouses were taken into the classrooms, and the original stimuli were used. Only praise was provided for correct responses, and no correction procedures were used during the classroom probe.

The second transfer test was conducted in an Activities of Daily Living (ADL) room by one of the school speech pathologists. A preassessment was conducted with 15 life-sized objects and 11 life-sized locations in the ADL room to ensure that known words were used with each subject. A 4 × 4 object-location matrix was generated for the two-dimensional matrix children, and each two-term combination was tested once in each modality. A 3 × 5 × 3 object-preposition-location matrix was generated for the three-dimensional matrix children, and each three-term combination was tested in either the receptive or the expressive modality. The five prepositions were those included in the subject's original matrices. Thus, the "real furniture" transfer test consisted of combinations of known object and location words. These combinations were presented as in the first transfer test. This second transfer test assessed the extent of generalization to additional word combinations and reflected generalization of language use to a third setting. The experimenter was not present during transfer testing; consequently, reliability measurements were not obtained.

Reinforcement and correction. Throughout the study social praise, edibles, and/or tokens were provided for correct responses. Although all correct responses on probe trials also were reinforced throughout the study, no consequences were programmed for incorrect responses.

To ensure that learning was accomplished through observation rather than direct training, correction procedures were instituted only with the peer models. The experimenter modeled the correct response and then repeated the trial. If the model again failed to respond correctly, the experimenter had the model imitate the correct response after repeating the instruction and the response.

Mastery criteria. Training blocks consisted of four data sheets, allowing the opportunity to include probe trials sampled from the entire matrix. Mastery was checked at the completion of each block. First, mastery of the training item was set at 87.5% correct responding over two consecutive data sheets. If the subject failed to meet this criterion for observational learning but progress was evident, modeling sessions continued with the same item. Second, mastery reflecting recombinative generalization was set at 50% correct responding to untrained responses in the training modality for 2 consecutive days.

If the mastery criteria for both training and recombinative generalization were met, a training item from an unknown word submatrix was selected to expand the subject's repertoire most efficiently. No progress for four sessions resulted in implementation of adjacent-trial observation training. If problems discriminating among training items were evident from systematic error patterns at the completion of four sessions, brief interventions (described in the Results) were implemented to stabilize learning.

Experimental Design

A multiple baseline design across responses was used to demonstrate that modeling resulted in generalized language learning. This research design also was used to demonstrate that the extent of recombinative generalization was related systematically to the implementation of matrix-training procedures. Each response (training item) was introduced sequentially as expressive observational learning of the modeled response and recombinative generalization were demonstrated within submatrices.

For each subject, Submatrix 1 consisted of all known words. The goal of the first training phase was to establish the word order rule for recombinative generalization of known words after peer modeling of a single expressive response. When the mastery criteria were met for learning T1 and for recombinative generalization in Submatrix 1, intervention proceeded to the unknown submatrices.

The selection of the new training item (T2) made generalization to untrained items in Submatrix 2 possible. Recombinative generalization within the unknown word submatrices required the subjects to produce two- or three-word combinations that included unknown words. The learning of the word order rule in Submatrix 1 provided a basis for subjects to determine the relationship between new words and their referents, thus enabling subjects to extend their lexical and syntactic repertoires. For object-location utterances, for example, the subjects could induce new word–referent relations consistent with the word order rule: The first word in the utterance refers to the object and last word refers to the location. In the three-dimensional matrix shown in Figure 2, *penny behind the cabinet* was the second training item (T2) for Subject 4. The cells in Submatrix 2 represented novel word combinations containing one of the unknown preposition and location words in the new training item (i.e., *behind* or *cabinet*). Responding consistent with the word order rule would be demonstrated if, after modeling of a single item within unknown submatrices, generalization across the rest of the submatrix was rapid and widespread.

The procedure and criteria for learing submatrix 2 were identical to those used with Submatrix 1. When the mastery criteria were achieved, training progressed to the next training item.

The effects of training responses within submatrices that included unknown words were replicated across submatrices 2 through 5 with Subjects 1, 2, and 3 and across submatrices 2 through 4 with Subjects 4, 5, and 6.

Recording Responses and Reliability

Each word of a training or probe response was recorded as correct (+) or incorrect (−) for each trial. In addition, all incorrect responses were documented by recording the receptive or expressive responses provided by the subject. Failure to respond and unintelligible responses also were recorded as incorrect responses. A training item was considered correct only if all words of the response were scored (+).

Reliability measures were recorded by an independent observer during training sessions approximately once a week for each subject. Reliability measures were obtained for 62 of the 147 sessions across all subjects. Reliability was calculated by comparing the trainer's and the observer's recordings of correct and incorrect responses on a trial-by-trial basis. Interobserver agreement was determined by dividing the number of agreements by the number of agreements plus disagreements and multiplying this value by 100. Reliability ranged from 93% to 100%, with a mean of 99.0%.

RESULTS

Observational Learning Effects

Table 2 shows the effects of peer modeling as each subject was exposed to successive expressive training items. Before modeling began, none of the subjects provided a correct expressive response to any of the training items. With the exception of one response each for Subjects 1 and 3, none of the subjects demonstrated a correct receptive response before modeling. When peer modeling was initiated, all subjects demonstrated observational learning of the initial responses. Acquisition of modeled responses was demonstrated during the modeling condition, with three exceptions. Subjects 3, 5, and 6 required further intervention to learn one training item each, T3 (Training Item 3), T3, and T4, respectively. The effects of expressive modeling also were evident in the receptive modality on opposite modality probes, although results were more variable.

Adjacent-trial observation training was implemented only with Subjects 3, 5, and 6 for one response each. As can be seen in Table 2, marked improvements in the receptive and expressive modalities were demonstrated during the adjacent-trial observation condition for Subjects 5 and 6. They met the 100% criterion on observational acquisition probes in one and two sessions, respectively. Subject 3 showed marginal improvement during two sessions of adjacent-trial observation. He persisted in calling the *scale* "bean." *Bean* was the object in the previous training item (T2). Because of this, Subject 3 received massed expressive training trials on *scale on nightstand* without a peer model. Subject 3's independent labeling performance fluctuated between 65% and 95% for 10 days before he met the 90% criterion for 2 consecutive days. Further intervention of this sort was not required for Subject 3; he learned two subsequent training items through observation.

Recombinative Generalization Effects

The effects of peer modeling were not restricted to the learning of individual responses. Figures 3 through 8 show the effects of peer modeling of expressive responses on receptive and expressive recombinative generalization within the submatrices from which the modeled responses were drawn.

During baseline conditions, generalized expressive responses were not demonstrated; however, generalized receptive responses were sometimes demonstrated for all subjects. Initially, this occurred when combinations included a known location and an unknown object; the limited set of objects allowed the subjects to choose objects at random or by a process of elimination and be reinforced for a correct response. This possibility was reduced by including only unknown object plus unknown lo-

Table 2
Summary of Correct Responding During Observational Learning of Training Items

Number of submatrix cells	Training item	% Correct (number of) observational acquisition probes		% Correct (number of) opposite modality probes	
		Baseline	Modeling	Baseline	Modeling
Subject 1					
SM1–9	button on table		94 (16)		100 (4)
SM2–7	barrette on dresser	0 (1)	100 (16)	0 (1)	25 (4)
SM3–9	scale on desk	0 (3)	100 (16)	100 (2)	100 (4)
SM4–11	spool on crib	0 (4)	94 (16)	0 (5)	75 (4)
SM5–13	screw on speaker	0 (6)	88 (16)	0 (7)	25 (4)
Subject 2					
SM1–9	button on potty		81 (16)		100 (4)
SM2–7	tee on plant	0 (1)	66 (32)	0 (1)	88 (8)
SM3–9	bean on stool	0 (5)	100 (16)	20 (5)	75 (4)
SM4–11	scale on crib	0 (7)	81 (16)	0 (7)	100 (4)
SM5–13	curler on desk	0 (9)	100 (16)	0 (9)	75 (4)
Subject 3					
SM1–9	key on bed		63 (24)		83 (6)
SM2–7	bean on couch	0 (1)	88 (16)	0 (2)	50 (4)
SM3–9	scale on nightstand	0 (3)	6 (16)	0 (4)	25 (4)
	two ATOT sessions:		13 (8)		50 (2)
			100 (8)		100 (2)
SM4–11	wrench on desk	0 (7)	88 (16)	0 (6)	100 (4)
SM5–13	eraser on fireplace	0 (9)	63 (16)	0 (10)	75 (4)
Subject 4					
SM1–18	button on rug		100 (16)		100 (4)
SM2–18	penny behind cabinet	0 (1)	63 (16)	0 (1)	50 (4)
SM3–24	comb left of nightstand	0 (2)	88 (16)	0 (1)	75 (4)
SM4–30	comb right of vanity	0 (2)	100 (16)	0 (3)	100 (4)
Subject 5					
SM1–18	balloon under TV		67 (24)		83 (6)
SM2–18	comb beside dresser	0 (1)	75 (16)	0 (1)	0 (4)
SM3–24	key behind hutch	0 (3)	0 (16)	0 (4)	50 (4)
	one ATOT session:		100 (4)		100 (1)
			100 (8)		100 (2)
SM4–30	key front of nightstand	0 (4)	75 (16)	0 (5)	50 (4)
Subject 6					
SM1–18	comb on bed		78 (32)		100 (8)
SM2–18	key front of hutch	0 (2)	75 (16)	0 (1)	100 (4)
SM3–24	money right of vanity	0 (2)	81 (16)	0 (2)	50 (4)
SM4–30	money left of cabinet	0 (3)	13 (24)	0 (3)	83 (6)
	two ATOT sessions:		75 (8)		50 (2)
			88 (8)		100 (2)

Note. ATOT, adjacent-trial observation training.

cation combinations in subsequent baseline testing (beginning with T2).

Exposure to successive modeling responses was sufficient to promote recombinative generalization in each submatrix for Subject 1 (see Figure 3). Only in Submatrix 3 was there an apparent loss of experimental control in the receptive modality; Subject 1, who offered diverse responses to baseline probes, was reinforced for a seemingly random correct response and produced two such correct "scale

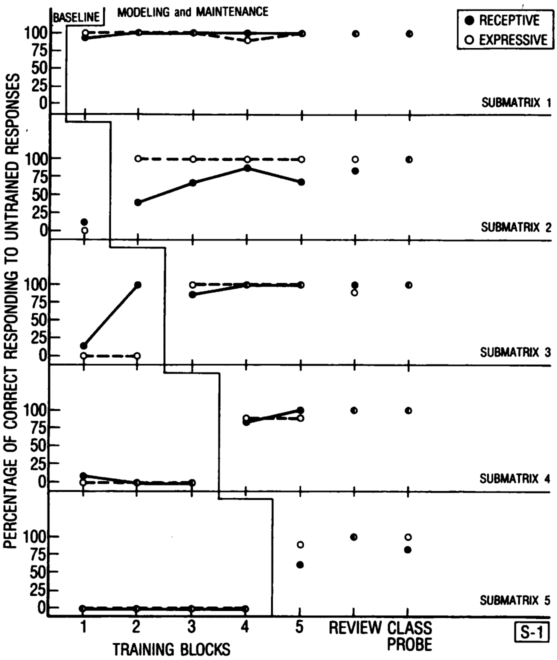

Figure 3. Percentage of generalized receptive and expressive responses for each submatrix taught to Subject 1. The vertical lines represent the initiation of expressive modeling of the five object-location training items. Closed circles denote receptive performance, and open circles denote expressive performance. The review data points reflect a test of all responses in the subject's matrix without the model present. The probe data points reflect a 50-item transfer test administered by the subject's teacher in the classroom.

on desk" receptive responses. Otherwise, it is notable that receptive recombinative generalization tended to lag behind expressive performance with Subject 1. Highly accurate generalized responding was demonstrated in the whole matrix review and in the classroom transfer probe.

In Figure 4, Subject 2 showed similar effects of peer modeling. Generalized responding in both modalities followed peer modeling of a single response from each submatrix. Expressive recombinative generalization remained inconsistent in Submatrix 2, because Subject 2 often substituted "tee" for "plant," which was the object associated with the location in T2 (*tee on plant*). Some instability remained in Submatrices 4 and 5 during the whole matrix review and the classroom transfer probe.

Peer modeling consistently produced recombinative generalization with Subject 3 (see Figure 5). Because of a lack of observational learning following modeling of T3 (from Submatrix 3) and limited expressive recombinative generalization, adjacent-trial observation training was implemented. As can be seen in Figure 5, expressive recombinative generalization improved after the direct training intervention described above (*for scale on nightstand*) was implemented. Receptive recombinative generalization lagged behind expressive performance for the last two submatrices. High levels of expressive recombinative generalization were evident during the whole matrix review and the classroom transfer probe.

Subject 4 learned a three-dimensional matrix. The effects of peer modeling were replicated across each of the four submatrices (see Figure 6). Performance levels were not as high for Submatrix 2; Subject 4 showed some confusion between *under* and *behind,* which was the new preposition introduced in Submatrix 2. This discrimination may have been difficult, because the objects often ended up out of view with both of these prepositions.

For Subject 5 (Figure 7), peer modeling had limited effects on recombinative generalization in Submatrix 3 until adjacent-trial observation training was implemented for a single session. It is notable that generalized expressive responding consistently approximated or surpassed generalized receptive responding. Errorless expressive recombinative generalization was demonstrated during the whole matrix review and the classroom transfer probe.

For the final subject, peer modeling also resulted in generalized responding (see Figure 8). Difficulties were evidenced during the learning of T4 (from Submatrix 4), however. Subject 6 confused the prepositions from T3 and T4, *right of* and *left of.* Recombinative generalization improved for Submatrix 4 when adjacent-trial observation training was instituted, but recombinative generalization declined in Submatrix 3. Consequently, Subject 6 received two sessions of direct training with T3 (*money right of vanity*), T4 (*money left of cabinet*), and a third, overlapping response (*money* *right of cabinet*). Few errors were demonstrated during the whole matrix review and the classroom transfer probe.

Transfer Testing

A summary of subjects' performance on the "real furniture" transfer test administered by a speech pathologist is presented in Table 3. Both expressive and receptive performance was quite high. There were three cases of decrements in performance that are noteworthy. First, three of Subject 3's four expressive errors involved reversing the word order of the object and location words. Second, Subject 5's receptive performance was low, reflecting a perseveration with the use of the preposition *beside* during the first half of the session. This confusion was not apparent previously. Third, a small decrement in Subject 6's performance indicated that confusions between *left* and *right* persisted when using life-sized stimuli.

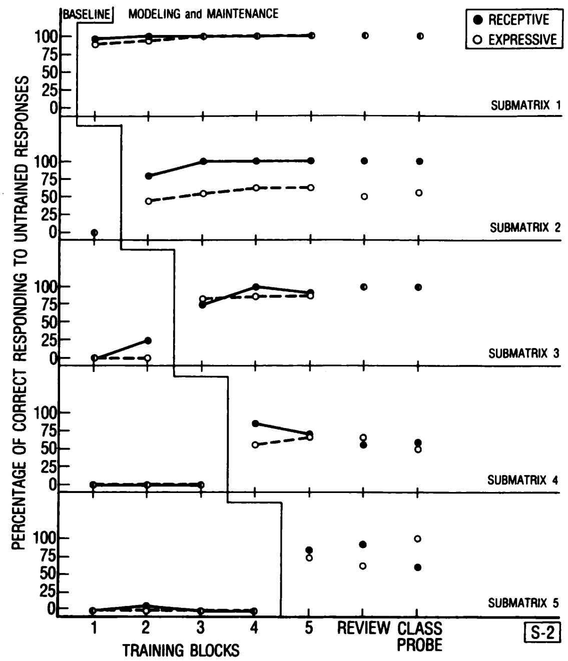

Figure 4. Percentage of generalized receptive and expressive responses for each submatrix taught to Subject 2. The vertical lines represent the initiation of expressive modeling of the five object-location training items.

DISCUSSION

All 6 children with mental retardation demonstrated observational learning of responses modeled by their peers. Subjects 1, 2, and 3 were given the opportunity to learn five object-location responses each; 14 of 15 of these responses were demonstrated subsequent to modeling. Subjects 4, 5, and 6 were given the opportunity to learn four object-proposition-location responses each; for 10 of 12 of these responses no further training was required. These findings are consistent with other studies involving individuals with severe handicaps that provide evidence that modeled responses consonant with the learner's language repertoires are likely to be learned observationally in structured settings (Egel, Richman, & Koegel, 1981; McCuller, 1980). It is not clear whether observational learning would be less effective if the modeled behaviors differed to a greater extent from those in the subjects' repertoires or if the behaviors were modeled in a setting with more distracting stimuli.

Because of the extensive observational learning demonstrated by the subjects, there were few opportunities to examine the short- and long-term effects of adjacent-trial observational training. With 3 subjects, adjacent-trial observation training was implemented and was sufficient to correct the difficulty experienced by Subject 5; she subsequently demonstrated observational learning of a response modeled in nonadjacent trials. Additional interventions were designed for Subjects 3 and 6 based on analyses of error patterns. These subjects seemed to experience discrimination problems rather than a lack of learning through observation. Once the discrimination problem associated with T3 was resolved for Subject 3, he demonstrated observational learning of two more responses modeled in nonadjacent trials.

An important finding of this study is that organizing modeling experiences according to matrix-training principles resulted in recombinative generalization by each of the subjects. Recombinative generalization effects may have been heightened by initially modeling responses combining known words

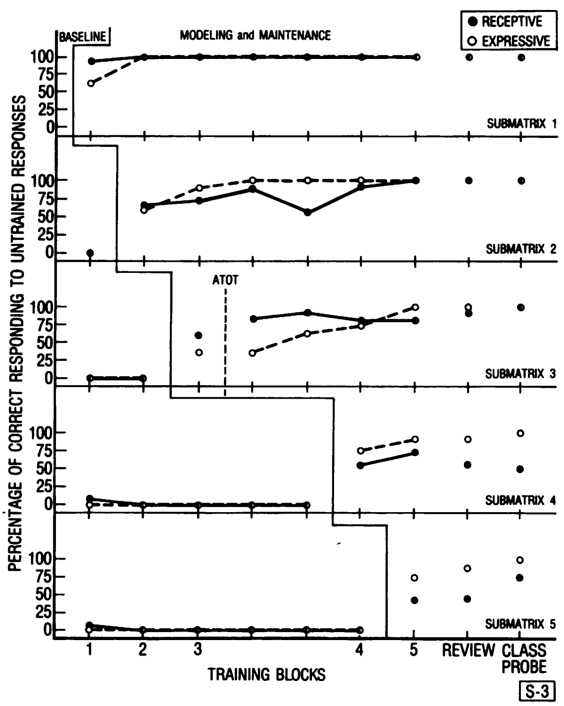

Figure 5. Percentage of generalized receptive and expressive responses for each submatrix taught to Subject 3. The vertical lines represent the initiation of expressive modeling of the five object-location training items, and the dashed vertical line represents the initiation of adjacent-trial observation training with the third training item.

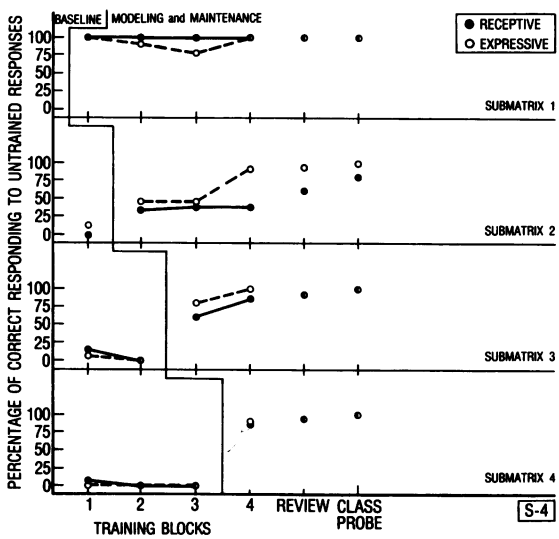

Figure 6. Percentage of generalized receptive and expressive responses for each submatrix taught to Subject 4. The vertical lines represent the initiation of expressive modeling of the four object-preposition-location training items.

before introducing unknown object, location, and preposition words (cf. Goldstein et al., 1987). Four or five expressive responses were modeled for all subjects, and additional intervention was implemented only for a single expressive response for each of 3 subjects. Observational training resulted in the production of 44 object-location utterances not trained directly for Subjects 1, 2, and 3. In addition, they learned 49 untrained receptive responses. Subjects 4, 5, and 6 learned to produce 86 object-preposition-location utterances not trained directly plus 90 untrained receptive responses. Thus, generalization processes appear to be just as robust when training is accomplished via peer modeling rather than through the direct matrix-training procedures implemented in prevous research (e.g., Goldstein et al., 1987; Romski & Ruder, 1984; Striefel, Wetherby, & Karlan, 1976, 1978). Generalization processes accounted for 95% to 98% of the responses learned.

Expressive modeling resulted in expressive and receptive language learning. Neither the observational acquisition data summarized in Table 2 nor the recombinative generalization data (Figures 3 through 8) showed a consistent advantage in one modality over the other; most often performance was similar in both modalities at any point in time. It is notable that receptive responding did not always precede expressive responding. It may be that this traditional hypothesis (cf. Ingram, 1974) needs to be reexamined in the context of complex tasks of approximately equal difficulty. Both the receptive and expressive tasks in this experiment required complex discriminative responding. The object manipulation response topography may be easier for the receptive task than is the verbal expression topography for the expressive task. But memory demands may be less for the expressive task; the object and location remain visible while the subject describes their orientation. In contrast, for the receptive task, object, preposition, and location words must be remembered while the subject selects the object, finds the location, and places the object in the appropriate orientation to the location. Further resolution of the relationship between expressive and receptive language learning requires careful

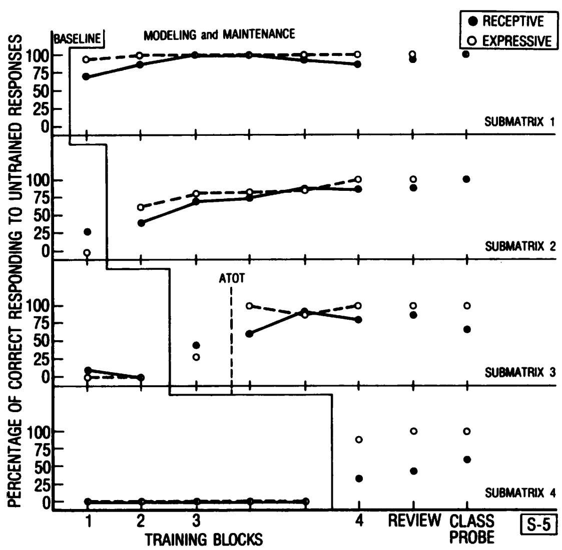

Figure 7. Percentage of generalized receptive and expressive responses for each submatrix taught to Subject 5. The vertical lines represent the initiation of expressive modeling of the four object-preposition-location training items, and the dashed vertical line represents the initiation of adjacent-trial observation training with the third training item.

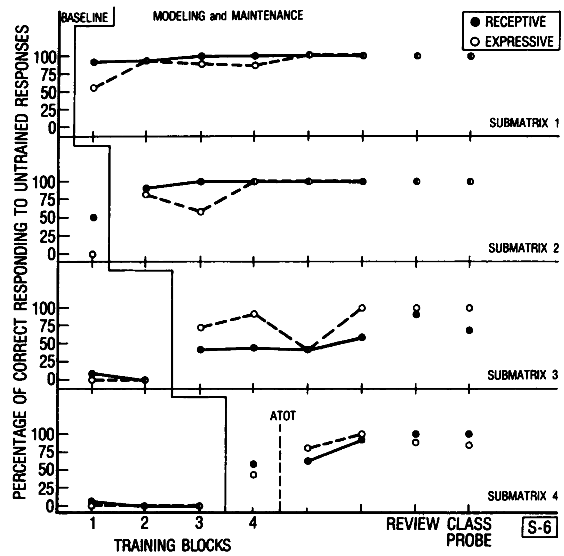

Figure 8. Percentage of generalized receptive and expressive responses for each submatrix taught to Subject 6. The vertical lines represent the initiation of expressive modeling of the four object-preposition-location training items, and the dashed vertical line represents the initiation of adjacent-trial observation training with the fourth training item.

analyses of the component behaviors that contribute to receptive and expressive language tasks as they relate to the present language repertoires of the learner.

All subjects showed an impressive degree of transfer of generalized responding to other school settings. In particular, high performance on the "real furniture" transfer tests by all subjects was remarkable for two reasons. First, the real furniture could not be placed facing the child as in the dollhouse. Therefore, subjects had to shift their perspective to the furniture items repeatedly. Second, spatial orientation differences also made differentiations between prepositions involving perimeters of locations, such as *right of, left of, in front of,* and *under,* more difficult. Nevertheless, generalization to more naturalistic stimuli and to a new examiner was impressive. Greater confidence in these results would be permitted, however, if baseline and reliability data could have been collected in these settings.

In conclusion, this study exemplifies the potential of coupling procedures to promote observational learning and recombinative generalization. It was impressive that all 6 subjects with severe mental retardation demonstrated observational learning. Consequently, there was little opportunity to examine the effects of interventions designed to broaden observational learning abilities (in particular, adjacent-trial observational learning). Likewise, there was little opportunity to determine whether pretest measures, especially imitation tasks, predicted successful progress through this experiment. Nonetheless, the selection of training items based upon the current technology for teaching language matrices allowed additional benefits to accrue. The observational learning of just a few responses was

Table 3
Summary of Real Furniture Transfer Test Results
(% Correct)

	Subject					
	1	2	3	4	5	6
Expressive	94	88	75	95	87	74
Receptive	100	100	100	100	50	81

sufficient to produce relatively large repertoires of new receptive and expressive language responses. The results of this study inspire confidence that one might be able to shift the context for observational language learning into more natural environments, such as the classroom, and teach functional language repertoires with great efficiency.

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